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**BEFORE THE BOARD OF PATENT APPEALS
AND INTERFERENCES**

Application Number: 10/535,466
Filing Date: May 17, 2005
Appellant(s): FRADKIN ET AL.

Michael Marcin (Reg. No. 48,198)
For Appellant

EXAMINER'S ANSWER

This is in response to the appeal brief filed on June 18, 2009 appealing from the Office action mailed January 21, 2009.

(1) Real Party in Interest

A statement identifying by name the real party in interest is contained in the brief.

(2) Related Appeals and Interferences

The examiner is not aware of any related appeals, interferences, or judicial proceedings which will directly affect or be directly affected by or have a bearing on the Board's decision in the pending appeal.

(3) Status of Claims

The statement of the status of claims contained in the brief is correct.

(4) Status of Amendments After Final

The appellant's statement of the status of amendments after final rejection contained in the brief is correct.

(5) Summary of Claimed Subject Matter

The summary of claimed subject matter contained in the brief is correct.

(6) Grounds of Rejection to be Reviewed on Appeal

The appellant's statement of the grounds of rejection to be reviewed on appeal is correct.

(7) Claims Appendix

The copy of the appealed claims contained in the Appendix to the brief is correct.

(8) Evidence Relied Upon

DELINGETTE ET AL., "General Object Reconstruction Based on Simplex Meshes", Vol. 32, No.2, August 1999, pp. 111-142.

6,201,889	VANNAH	3-2001
6,968,299	BERNARDINI ET AL.	11-2005

(9) Grounds of Rejection

The following ground(s) of rejection are applicable to the appealed claims:

Claim Rejections - 35 USC § 103

The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

[R1] Claims 1, 2 and 15 are rejected under 35 U.S.C. 103(a) as being unpatentable over Delingette (General Object Reconstruction Based on Simplex Meshes, 1999).

Regarding claim 1, Delingette teaches: An image processing method having image data processing means of automatic adaptation of 3-D surface Model to image features ("The first stage corresponds to the mesh deformation from an initial position to a close approximation of the dataset shape", Delingette, page 127, column 1, paragraph 4), for

Model-based image segmentation ("The different tasks performed during the reconstruction include the segmentation of given objects in the scene", Delingette, page 111, abstract) comprising means of dynamic adaptation of the Model resolution to image features (Delingette, page 121, figure 9b) including means of locally setting higher resolution when reliable image features are found and means of setting lower resolution in the opposite case ("Simplex meshes as triangulations are unstructured meshes and therefore can be locally refined or decimated", Delingette, Page 118, column 2, paragraph 2, and table 5 showing high refinement corresponding to reduced distance error); and comprising viewing means for visualizing the images ("a disadvantage of using simplex meshes over triangulations is that they must be triangulated in order to be displayed", Delingette, page 135, column 1, paragraph 3).

Delingette does not expressly disclose an image processing system.

However, Delingette provides ample evidence that he has implemented his system ("DEC Alphastation 200/233", page 137, column 2, paragraph 4. He also makes mention of his "system" multiple times: "In this paper we present a shape recovery system", page 114, column 2, paragraph 3, and "In Section 4, we describe the various components of our reconstruction system", page 114, column 2, paragraph 5. He also makes reference to his implementation: "In the current implementation, we rely on an initialization algorithm that is limited to only three different topologies", Delingette, page 141, paragraph 4. Delingette has clearly implemented his system)

It would have been obvious at the time the invention was made for one of ordinary skill in the art to provide the structure implied by Delingette to implement the methods

disclosed by Delingette to actually implement the methods to generate a high quality reconstruction of an object using simplex meshes.

Regarding claim 2, Delingette discloses data processing means to define a feature confidence parameter for each image feature ("the refinement measure is linked to the maximum distance to the data", Delingette, page 137, column 2, paragraph 1), and to locally adapt model resolution according to it ("Meshes before and after refinement are shown in Fig. 27", Delingette, page 173, column 2, paragraph 2).

Regarding claim 15, Delingette discloses [a]n image processing method, comprising steps off acquiring image data of a 3-D image with image features, and automatically adapting 3-D surface Model to image features, for Model-based image segmentation ("The first stage corresponds to the mesh deformation from an initial position to a close approximation of the dataset shape", Delingette, page 127, column 1, paragraph 4), whereby: dynamically adapting the Model resolution to image features including locally setting higher resolution when reliable image features are found and setting lower resolution in the opposite case ("the refinement measure is linked to the maximum distance to the data", Delingette, page 137, column 2, paragraph 1) and comprising steps of visualizing the images ("a disadvantage of using simplex meshes over triangulations is that they must be triangulated in order to be displayed", Delingette, page 135, column 1, paragraph 3 and figures 27 and 29 are examples of Delingette's output images).

[R2] Claims 3-7 are rejected under 35 U.S.C. 103(a) as being unpatentable over Delingette (1999) in combination with Bernardini et al. (US 6, 968,299 B1).

Regarding claim 3, Delingette teaches a data processing means to define a feature confidence parameter as a parameter that depends on the feature distance ("the refinement measure is linked to the maximum distance to the data", Delingette, page 137, column 2, paragraph 1) and having data processing means to penalize the large distances ("Meshes before and after refinement are shown in Fig. 27", Delingette, page 173, column 2, paragraph 2).

Delingette does not explicitly describe the estimation of quality of this feature including estimation of noise, and having data processing means to penalize the noisy, although close features.

Bernardini working in the same field of endeavor of 3d modeling through mesh generation ("a method and apparatus are disclosed for finding a triangle mesh that interpolates a set of points obtained from a scanning system", Bernardini, column 3, line 47) does teach the estimation of quality of this feature including estimation of noise, and having data processing means to penalize the noisy, although close features ("points lying below the surface will not be touched by the ball and will not be part of the reconstructed mesh, as shown in FIG. 2F", Bernardini, column 8, line 41, and "the ball-pivoting algorithm is robust in the presence of imperfect data", Bernardini, column 8, line 24, Bernardini's method omits noisy points resulting in coarser resolution in those regions).

It would have been obvious at the time the invention was made for one of ordinary skill in the art to use the ball-pivoting algorithm of Bernardini with the simplex mesh system of Delingette to provide a triangulation method that is "robust in the presence of imperfect data" (Bernardini, column 8, line 24)

Regarding claim 4, the combination of Delingette and Bernardini teaches data processing means for decreasing the resolution of the Model in absence of confidence and gradually increasing the resolution of the Model with the rise of feature confidence (Delingette, figure 27 shows resolution varying as a result of a refinement operation).

Regarding claim 5, the combination of Delingette and Bernardini discloses data processing means for causing low local resolution to constrain local surface curvature, for preventing the model surface from self-intersections ("Our deformable model framework is based on a Newtonian law of motion (see Eq. (10)) that includes a damping factor in order to prevent oscillations of the system." Delingette, page 135, column 2, paragraph 1 and "For $\gamma = 0.20$, we observe that the resulting mesh self-intersects", Delingette, page 136, paragraph 1, and "If γ is too small, the mesh may not converge towards the right shape, especially when the mesh is far away from the data.", Delingette, page 136, paragraph 2, Delingette reveals that when the mesh is farther away, as will occur at lower resolution, the mesh may not converge properly. He provides a damping mechanism to increase the stability of the deformation in order to avoid self-intersection).

Regarding claim 6, the combination of Delingette and Bernardini discloses means to make feature confidence available for model adaptation, comprising means to display the Model regions with different colors representing the confidence at the location of said regions for the user to supervise the deformation process of the Model and to locally assess its final quality (Delingette, Figure 21 (b) – color coding of the distance of mesh vertices to the dataset).

Regarding claim 7, the combination of Delingette and Bernardini teaches means for: generating a Mesh Model, formed of polygonal cells and deforming the Mesh Model in order to map said Mesh Model onto said object of interest ("The first stage corresponds to the mesh deformation from an initial position to a close approximation of the dataset shape", Delingette, page 127, column 1, paragraph 4, and figure 25)

The combination of Delingette and Bernardini given above does not explicitly teach a means for [a]cquiring a three-dimensional image of an object of interest to be segmented.

Bernardini further teaches a means for [a]cquiring a three-dimensional image of an object of interest to be segmented ("The acquisition system 120 may be embodied, for example, as Rapid 3D Color Digitizer Model 3030, commercially available from CyberWare of Monterey, Calif", Bernardini, column 5, line 17).

It would have been obvious at the time the invention was made to one of ordinary skill in the art to use a 3D digitizer as taught by Bernardini in the combination of Delingette and Bernardini because "the acquisition system 120 produces sets of range images, i.e. arrays of depths, each of which covers a subset of the full surface", Bernardini, column 5, line 20, a source of data is needed for the system to have any utility).

[R3] Claims 8-14 are rejected under 35 U.S.C. 103(a) as being unpatentable over Delingette (1999) in view of Bernardini et al. (US 6, 968,299 B1) further in view of Vannah (US 6,201,889).

Regarding claim 8, the combination of Delingette and Bernardini teaches the elements of claim 7 as given above.

While the combination of Delingette and Bernardini does teach color coding the mesh as indicated above, the combination of Delingette and Bernardini does not teach means for: Constructing a Color Coding Table wherein predetermined colors are associated to given confidence parameter values; Associating the confidence parameter values of a given cell of the Mesh Model to a color given by the color coding Table corresponding to said confidence parameter values.

Vannah, working in the same problem solving area of providing user feedback of 3D data quality, does teach means for ("a processor connected to the probe and the output device and arranged to analyze the digital data and provide a feedback code indicating the quality of the digital data points", Vannah, column 3, line 63): Constructing a Color Coding Table wherein predetermined colors are associated to given confidence parameter values ("In a sixth step, 60, the system draws the compartment on a 3-D map, e.g., on a CRT, with the feedback code, e.g., a visual code, corresponding to the calculated quality", Vannah, column 9, line 27); Associating the confidence parameter values of a given cell of the Mesh Model to a color given by the color coding Table corresponding to said confidence parameter values ("This is accomplished by obtaining the proper feedback code signal for each compartment from a look-up table in memory that associates particular code signals with specific quality values", Vannah, column 9, line 29).

It would have been obvious at the time the invention was made for one of ordinary skill in the art to combine the color coded feedback means and method taught by Vannah in the adaptive mesh system of the combination of Delingette and Bernardini to "provide the user real-time feedback as to the quality of the data at any area of the map. The feedback code indicates whether the data obtained at a particular location is acceptable, thus signaling the user to re-sample locations in which sampling was too sparse, erroneous, or contained excessive noise (random error)", Vannah, column 2, line 66).

Regarding claim 9, the combination of Delingette, Bernardini and Vannah teaches a data processing means for ("a processor connected to the probe and the output device and arranged to analyze the digital data and provide a feedback code indicating the quality of the digital data points", Vannah, column 3, line 63): Performing a color coding operation by attributing to said given cell, the color determined from the Color Coding Table, corresponding to the confidence parameter values ("This is accomplished by obtaining the proper feedback code signal for each compartment from a look-up table in memory that associates particular code signals with specific quality values", Vannah, column 9, line 29); and display means for ("the output device can be, e.g., a cathode ray tube or other screen, or a printer", Vannah, column 4, line 10): Displaying the image of the Mesh Model having cells colored according to the color- coding operation ("transmit the feedback code to the output device", Vannah, column 4, line 8).

Regarding claim 10, the combination of Delingette, Bernardini and Vannah teaches wherein the color-coding operation is performed for all the cells or for a predetermined number of cells ("This is accomplished by obtaining the proper feedback code signal for each compartment from a look-up table in memory that associates particular code signals with specific quality values", Vannah, column 9, line 29, Vannah can code all the cells).

Regarding claim 11, the combination of Delingette, Bernardini and Vannah as given above does not teach means for: Taking a decision to stop the process of mapping the Mesh Model onto the object of reference in function of a predetermined confidence level.

Vannah does further teach means for: Taking a decision to stop the process of mapping the Mesh Model onto the object of reference in function of a predetermined confidence level ("If the key pressed was "F" (or some other, different, specific key) (step 85), the system leaves the sampling loop, and proceeds to step 90. Note that this step requires that the operator, or some automated machine, make a decision that the quality everywhere on the map is sufficient for a given purpose. This step 85 can also be accomplished without a keystroke, i.e., the system can determine that all compartments meet required quality values and provide a signal to the operator, or an automated sampling probe, that sampling is complete", Vannah, column 11, line 43).

It would have been obvious at the time the invention was made for one of ordinary skill in the art to use the means and method taught by Vannah to stop a mapping operation with the adaptive mesh system of the combination of Delingette, Bernardini and Vannah to indicate that mapping is complete or to abort a mapping early.

Regarding claim 12, the combination of Delingette, Bernardini and Vannah does teach [a] medical imaging system comprising a suitably programmed computer or a special purpose processor having circuit means, which are arranged to form an image processing system as claimed in claim 11 to process medical image data ("DEC Alphastation 200/233", Delingette, page 137, column 2, paragraph 4; and display means to display the images ("the output device can be, e.g., a cathode ray tube or other screen, or a printer", Vannah, column 4, line 10).

Regarding claim 13, the combination of Delingette, Bernardini and Vannah teaches [a] medical examination imaging apparatus having: Means to acquire a three- dimensional image of an organ of a body ("The acquisition system 120 may be embodied, for example, as Rapid 3D Color

Digitizer Model 3030, commercially available from CyberWare of Monterey, Calif", Bernardini, column 5, line 17 and "In this example. we reconstruct the ventricles, atria and the pericardium from a TI-weighted MRI volumetric image", Delingette, page 138, column 2, paragraph 2, the system could use MRI data or body surface data via a digitizer), and a medical imaging system according to claim 12 (as described above for claim 12).

Regarding claim 14, the combination of Delingette, Bernardini, and Vannah as given above teaches the system of claim 11.

The combination of Delingette, Bernardini and Vannah does not teach [a] computer program product comprising a set of instructions to be used in a system as claimed in claim 11.

Vannah further teaches [a] computer program product comprising a set of instructions to be used in a system as claimed in claim 11 ("The invention further features a computer program for analyzing the quality of sampled data points representing a property of an object and generating a feedback code indicating the quality of the sampled data points", Vannah, column 4, line 26, Vannah teaches encoding a method as a computer program).

It would have been obvious at the time the invention was made for one of ordinary skill in the art to use the teaching of Vannah to create a software program to implement the methods of the combination of Delingette, Bernardini and Vannah in order to quickly and easily produce additional systems for sale and to allow convenient updates and improvements to the systems in the future via low cost software upgrades.

(10) Response to Argument

Summary of Arguments:

Regarding claims 1-15 applicant argues that (emphasis added), "A high frequency noise in the image *may* result in a very high curvature value because the noise is found in the high frequency content. Since a noisy image having high curvature values is not a reliable image feature, therefore, an area having points of high curvature value does *not necessarily* imply that it is a reliable image feature." [Brief: page 5, para. 1].

Examiner's Response:

Regarding claims 1-15 Examiner contends that:

1. The claim does not require any criteria to be met in order to qualify as "reliable image features". Hence, any feature can be qualified as "reliable image features". In the extreme case, high curvature values in a noisy image can be qualified as "reliable image features".
2. The fact that *some* high curvature regions are unreliable does not by itself exclude high curvature regions from being reliable.

(11) Related Proceeding(s) Appendix

No decision rendered by a court or the Board is identified by the examiner in the Related Appeals and Interferences section of this examiner's answer.

For the above reasons, it is believed that the rejections should be sustained.

Respectfully submitted,

/Sath V Perungavoor/

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Conferees:

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